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GASTRIC NEMATODES, INCLUDING A NEW SPECIES OF *ABBREVIATA* (NEMATODA: PHYSALOPTERIDAE) FROM THE MANGROVE MONITOR *VARANUS INDICUS* (REPTILIA: VARANIDAE)

by H. I. Jones

Summary

Jones, H. I. (000) Gastric nematodes, including a new species of *Abbreviata* (Nematoda: Physalopteridae) from the mangrove monitor *Varanus indicus* (Reptilia: Varanidae). *Trans. R. Soc. S. Aust.* **128**(1), 53-59, 31 May, 2004.

Three species of nematode, *Tanqua tiara* (von Linstow, 1879), *Heliconema longissima* (Ortlepp, 1922), and *Abbreviata melanesiensis* sp.nov., were recovered from the gastrointestinal tracts of 124 *Varanus indicus* (Daudin, 1802). *Tanqua tiara* occurred in two-thirds of the lizards, at a mean prevalence of 7.2 worms per infected host. It is suggested that the low intensity and geographically variable prevalence of this nematode may relate to the distribution of the invertebrate intermediate host in the discrete and discontinuous insular habitat of the lizard. *Abbreviata melanesiensis* sp. nov. was recovered from two lizards, and is distinguished from other species in this genus principally by the enlarged tip of the right copulatory spicule, the thick sheath which envelops the retracted left spicule, the relatively conspicuous phasmids in females, and the elongated, thin-walled eggs. A single male *Heliconema longissima* was recorded.

Key Words: *Varanus indicus*, *Tanqua tiara*, *Abbreviata melanesiensis*, *Heliconema longissima*, Solomon Islands, Papua New Guinea, Indonesia, Australia.

Introduction

The mangrove monitor, *Varanus indicus* (Daudin, 1802), has a wide and discontinuous distribution from Sulawesi in eastern Indonesia, east through Papua New Guinea and northern Australia to the Solomon, Caroline and Marshall Islands (De Lisle 1996). The taxonomy of the monitor lizards in the *Varanus indicus* complex has recently been revised (Boehme *et al.* 1994, Philipp *et al.* 1999) to include several closely-related species. *Varanus indicus* sensu lato is found close to water, on beaches or riverbanks, and in swampy and mangrove areas (Cogger 1992). It is largely a terrestrial feeder, and its diet principally comprises crabs (especially grapsoid), smaller reptiles, mammals and birds, and occasionally turtles' eggs (McCoy 1980). It is a diurnal lizard, and when alarmed will take to water (Cogger 1992), although in the Solomon Islands it will invariably climb a tree (McCoy 1980).

Confusion in the nomenclature of *Varanus* lizards has resulted in a number of nematodes being attributed erroneously to *Varanus indicus* from India (Ortlepp 1922, Mirza 1934, Sharief 1957, Deshmukh 1969, Ali & Ilyas 1969). Since these records are far to the west of the known geographical range of *V. indicus*, and as all state or imply that the lizards were locally obtained and were not exotic specimens held in captivity, it is probable that these nematode records pertain to *V. bengalensis* (Daudin, 1802), or possibly *V. flavescens* (Hardwick and Gray, 1827) or *V. griseus koniecznyi* Mertens, 1954 (De Lisle 1996).

Little is known of the internal parasites of *Varanus indicus*. The nematode *Kalicephalus megacephalus* Schad, 1962 was described from this host from Florida Island in the Solomon Islands by Schad (1962). *Tanqua tiara* (Von Linstow, 1879) is primarily a nematode parasite of lizards in the genus *Varanus*, and has been recorded from a number of *Varanus* spp. from Africa to southeast Asia and northern Australia, in aquatic or coastal habitats, but has not hitherto been reported from *V. indicus* (see Gibbons and Keymer 1991). The present study was therefore undertaken to ascertain the nematode fauna of *Varanus indicus* sensu lato, as part of a study of the gastrointestinal nematodes of varanid lizards.

Materials and Methods

The results of dissections of 124 *Varanus indicus* are presented. Thirty seven *V. indicus* held in the collection of the Australian Museum, Sydney, and one from the collection of CSIRO Sustainable Ecosystems, Canberra, were examined. Dennis King forwarded nematodes recovered from stomach contents of 20 *V. indicus* collected from islands and small archipelagos of Bandaneira, Aru, Kai Besar, Yamdena and Selaru in the Moluccas in south and eastern Indonesia during Western Australian Museum/Museum Zoologicum Bogoriense expeditions in 1992/1993. In addition, nematodes from stomachs of sixty-six *V. indicus* collected at Maningrida in the Northern Territory by Tim Schultz

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during 2001 were removed by Alain de Chambrier and identified by Ian Beveridge and the author. The snout-vent length (SVL) of 58 hosts examined varied from 135 and 550 mm (mean = 335mm). Measurements were not available from lizards from Maningrida. The viscera were removed, and stomachs (and the intestines from the Australian Museum specimens) examined for helminths. Food residues were noted. All nematodes collected were cleaned, and stored in 70% alcohol with 10% glycerine. They were subsequently cleared in chlorolactophenol for examination. All specimens have been returned to the Australian Museum, Western Australian Museum, CSIRO and the Australian Helminth Collection respectively.

Results

Helminths recovered. Three species of nematode were recovered. The predominant species was *Tanqua tiara*, which was present in 75/124 lizards (60.5%, Fig. 1); specimens lodged as Australian Museum W 28660-W 28674; CSIRO Canberra N5294; Western Australian Museum V 4374 and V 4375, and in the Australian Helminth Collection. Prevalence was highest in the lizards from Maningrida (84.8%), and lowest from the Moluccas and Solomon Islands (32.8%). Total mean intensity of *T. tiara* was 7.2 worms/host. Four *V. indicus*, collected from Adelaide River and Maningrida in the Northern Territory, contained >20 *T. tiara* (22 – 123); in the remaining 71 infected hosts *T. tiara* numbers ranged from 1 – 16 (mean: 4.2). In four hosts some nematodes were attached with their heads buried in the stomach mucosa. A single male *Heliconema longissima* (Ortlepp, 1922) was recovered from a lizard from Maningrida in the Northern Territory. A new species of *Abbreviata* was recovered from two hosts collected from New Britain and from Woodlark Island, Papua New Guinea.

There was no relation between the size of the host lizard, type of food residues in the stomach, and the presence or intensity of infection with *T. tiara*. Both prevalence and intensity of this worm from lizards collected from the Moluccan islands in south-eastern Indonesia were lower (2 of 20 infected with one and two worms, respectively) than those collected from Papua New Guinea or the Solomon Islands, with highest prevalence and intensity in lizards from northern Australia. Neither of the two lizards with the new species of *Abbreviata* was concurrently infected with *T. tiara*. One of the two lizards infected with this species of *Abbreviata* was one of the largest dissected (500 mm SVL).

Food residues. In the 37 *V. indicus* from Papua New Guinea and the Solomon Islands, crustacea, in three

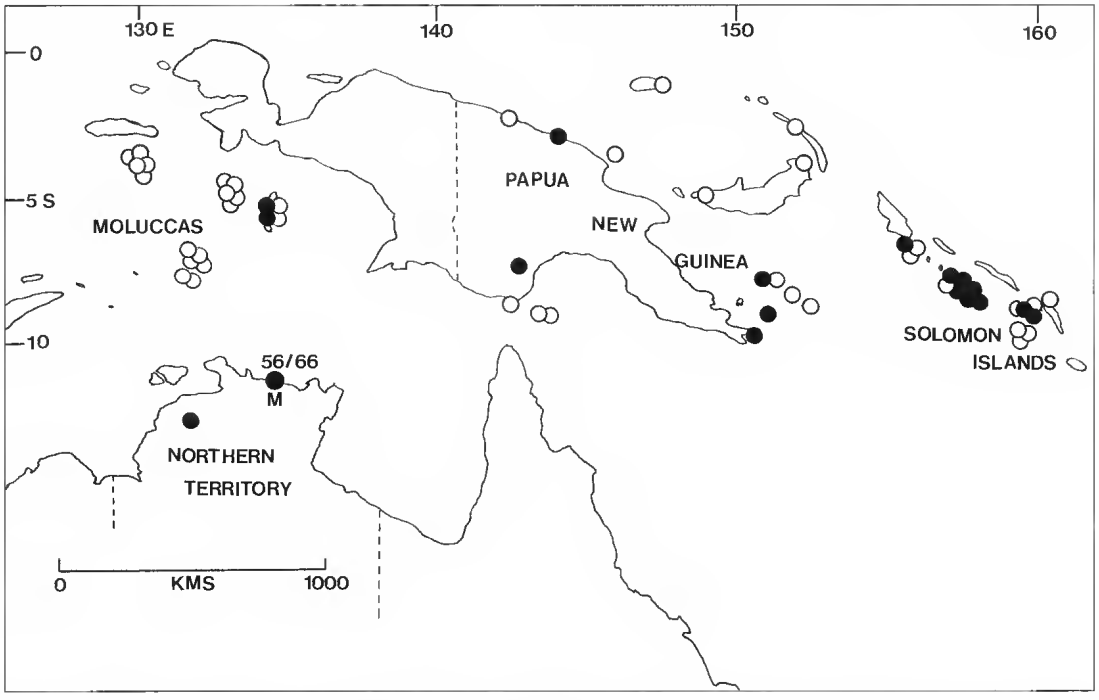

Fig. 1. Map showing distribution of *Tanqua tiara* in *Varanus indicus*. Open circle, lizard without infection; black circle, lizard with infection. M: Maningrida, where 56 of 66 lizards were infected. (No location data available for two lizards).

cases identifiable as crabs, formed the most commonly recovered food source, and occurred in 16 lizards. In addition, a snake (*Candoia* sp.; Boidae), an agamid lizard skull, an unidentified lizard, a frog, reptile eggs, cicadas, a grasshopper, and a beetle were each recovered from a single host stomach, and vertebrae from an unidentified animal, and molluscs from two hosts each. Stomach contents from the 20 lizards from the Indonesian islands included 10 with insect remains, one with a gecko, one with a bird, one with reptile eggs, one with a crab, and four with plant residues. Twenty one of these fifty seven stomachs had no food residues; no fish remains were identified.

Taxonomy

Order Spirurida
Superfamily Physaloptcroidea
Family Physalopteridae

Genus *Abbreviata* Travassos, 1920.
Abbreviata melanesiensis sp. nov.

Holotype

Male, Australian Museum W 28675, from stomach of *Varanus indicus*, AM R129614, Amelei village, West New Britain, Papua New Guinea (06° 06′ S, 150° 37′ E), collected 27.xii.1988.

Allotype

Female, AM W 28676, same data as for holotype.

Paratypes

16 males, 9 females, 4 larvae/immatures, AM W 28677, same data as for Holotype. Additional non-type specimens: three males, four females and two immatures, AM W 28678, from *V. indicus* R124815, collected Guasopa, Woodlark Island, Milne Bay Province, Papua New Guinea (09° 15′ S, 152°, 56′ E), collected 09.viii.1987.

Diagnosis

With characteristics of the genus, viz. two large lateral pseudolabia, with externolateral tooth present on each pseudolabium, a bifid internolateral tooth and two double pairs of submedian teeth; male with wide ornamented caudal alae united anteriorly on ventral surface of body, supported by four pairs of pedunculate papillae, markedly unequal spicules, females with vulva in anterior portion of body.

Mouth with dorsal and ventral corner denticles. Spicules well sclerotised, left four times length of right; left spicule in thick walled sheath, terminating in a very fine point, right spicule curved ventrally, with pointed, weakly-sclerotised enlargement at tip. Female tail slightly attenuated, vulva flush with body wall without extensions; eggs thin-shelled, elongate, length approximately twice width.

Description (Fig. 2)

Small to medium worms, males not greatly smaller than females, tapering at both ends, fine transverse cuticular striations. Mouth surrounded by two pseudolabia, each bearing large externolateral apical tooth and small bifid internolateral tooth. Bifid submedial tooth on dorsal and ventral border of each pseudolabium. Four to 5 small, regular denticles at dorsal and ventral median surface of each pseudolabium. Two sessile papillae and amphid on external surface of each pseudolabium. Cervical collar present. Nerve ring surrounds muscular oesophagus near its posterior end. Glandular oesophagus of uniform width, wider than muscular portion. Cervical papillae and excretory pore on external surface posterior to origin of glandular oesophagus.

Male

Caudal alae meet anteriorly, extend just beyond tip of tail posteriorly. Alae supported by four pairs of pedunculate pericloacal papillae and three pairs of very short pedunculate or sessile caudal papillae, of which the central pair is about one-third the distance between the first and second pair. Papillae on ventral surface sessile, 3 immediately anterior to the cloaca, and 2 pairs immediately posterior to the cloaca. Caudal tubercles arranged in rows, extending from anterior border of alae, converging towards cloaca, and running parallel to one another lateral to cloaca on ventral surface of tail and adjoining alae; diminishing in size posteriorly, terminating as small scattered tubercles at level of posteriormost caudal papillae. Spicules dissimilar, unequal. Left spicule approximately 4 times length of right, uniformly sclerotised, terminating in very fine tapering point, enclosed in conspicuous thick sheath. Right spicule thicker than left, heavily sclerotised, curved ventrally, and with a weakly-sclerotised pointed enlargement, slightly concave on one side, at the tip.

Female

Tail short, terminating in a slight attenuation; phasmids relatively conspicuous at two-thirds distance along tail. Vulva a transverse slit flush with body wall, without extensions or altered adjacent cuticle, posterior to commencement of intestine, about one-quarter of distance from anterior end of worm. Two ovaries, uterus with four branches, one of which often extends a variable distance anteriorly beside the posterior portion of glandular oesophagus. Eggs with smooth thin shells, elongate, embryos not visible, length almost twice width.

Measurements (mm; range with mean in brackets) Males (N:6): length 18 – 24 (21.7); maximum width 0.36 – 0.54 (0.45); muscular oesophagus length 0.26

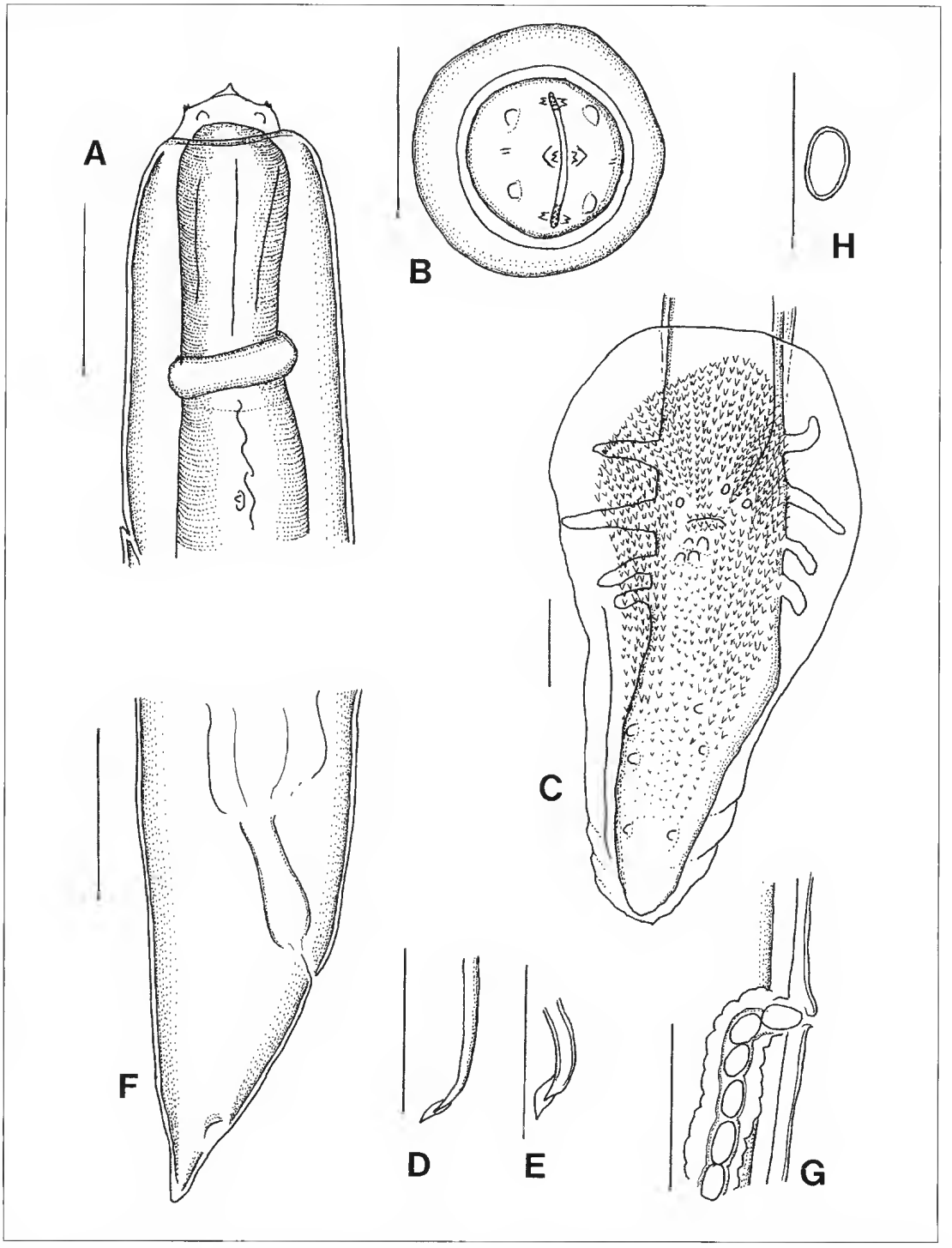

Fig. 2. *Abbreviata melanesiensis* sp. nov. A, anterior end, male paratype, lateral view; B, anterior end, *en face*, female paratype; C, male tail, slightly-oblique ventral view; D and E, distal tip of right spicule, male paratype; F, tail, female paratype, lateral view; G, eggs in oviduct and vulva, female paratype, lateral view; H, egg. Scale bars, E and H: 100μm, all other figures, 200μm.

– 0.36 (0.33); muscular oesophagus width 0.10 – 0.14 (0.12); glandular oesophagus length 2.8 – 3.3 (3.2); glandular oesophagus width 0.24 – 0.28 (0.26); nerve ring* 0.26 – 0.38 (0.32); cervical papillae* 0.36 – 0.68 (0.53); excretory pore* 0.56 – 0.72 (0.61); tail 0.96 – 1.32 (1.16); distance between caudal papillae 1 and 2, 0.056 – 0.16 (0.11); distance between caudal papillae 2 and 3, 0.14 – 0.19 (0.16); left spicule 1.320 – 1.680 (1.470); right spicule 0.280 – 0.360 (0.320). Females (N: 6) length 26 – 33 (29.3); maximum width 0.62 – 0.74 (0.70); muscular oesophagus length 0.36 – 0.44 (0.41); muscular oesophagus width 0.14 – 0.18 (0.15); glandular oesophagus length 3.36 – 4.40 (3.93); glandular oesophagus width 0.26 – 0.41 (0.32); nerve ring* 0.34 – 0.38 (0.36); cervical papillae* 0.48 – 0.60 (0.54); excretory pore* 0.62 – 0.86 (0.70); tail 0.34 – 0.44 (0.38); vulva†1.9 – 3.7 (2.78); 19.4% – 27.8% (23.3%) of distance from anterior end (* distance from anterior end; † distance posterior to oesophago-intestinal junction).

Discussion

Taxonomy

Abbreviata melanesiensis sp. nov. is distinguished from other species of *Abbreviata* occurring in reptiles from the Australo-Papuan region by a suite of characters. The size, general form, characteristics of the anterior end and the male copulatory bursa are shared with a number of other species. However, the weakly-sclerotised enlargement at the tip of the right spicule is unique; a similar feature occurs in *A. hastaspicula* Jones, 1979, in which species however it is well sclerotised (Jones 1979). Furthermore, in that species the left spicule is considerably shorter (0.620 – 0.700 mm) and the right spicule longer (0.590 – 0.670 mm: Jones 1979) than in *A. melanesiensis* sp. nov., and the sclerotisation of the left spicule often appears discrete and discontinuous; in addition, in *A. hastaspicula* the female bears a tubular extension from the vulva. Eggs of *A. melanesiensis* sp. nov. are elongate and thin walled; most species of *Abbreviata* in this region possess eggs with thicker and denser shells (Jones 1983b, 1988) except *A. hastaspicula* and *A. perenticola* Jones, 1985, whose thin shelled eggs are subspherical. Other characteristics which differentiate this species include less disparity in length between males and females, the thick sheath that envelops the retracted left spicule, and the readily visible phasmids on tails of females. In other species of *Abbreviata* described from Australia and Papua New Guinea, except *A. levicauda* Jones, 1983, from *V. tristis* (Schlegel, 1839) the penultimate caudal papillae are closer to the anterior papillae (Jones 1986) than in *A. melanesiensis* sp. nov. The enlargement at the tip of the right spicule distinguishes *A. melanesiensis* sp. nov. from six other species of *Abbreviata* recorded from Papua New Guinea, viz. *A. oligopapillata* (Kreis, 1940) (see Jones 1979), *A. multipapillata* (Kreis, 1940), *A. natricis* (Kreis, 1940), *A. heterocephala* (= *Kreisiella*) (Kreis, 1940), *A. confusa* Johnston & Mawson, 1942, (see Jones 1983a) and *A. kaulensis* (Jones, 1979). *A. borneensis* Schad, 1959 from *V. rudicollis* Gray, 1843 in Sarawak also has the posterior portion of the tail free from tubercles, as in *A. oligopapillata* (Schad 1959). In *A. melanesiensis* sp. nov. the delicate enlargement at the tip of the right spicule is not visible unless this is extended through the cloaca, and if this spicule is retracted, dissection is necessary to ascertain its character; all specimens in the type host had the right spicules retracted, but in all four males in the second host the right spicules were extended and this character was clearly visible. The small denticles at the dorsal and ventral mouth margins are often not visible if obscured by the cervical collar.

Biology

The absence of a relationship between host size and numbers of *T. tiara* contrasts with the findings of Shine *et al.* (1998), who found that *T. tiara* were present at a higher intensity in juvenile *V. salvator*. They also found a significant difference in infection with this worm between two sites in Sumatra, though the intensity of worms was similar to findings from *V. indicus* in the present study (mean 6.1 worms per host). The arthropod intermediate host for *T. tiara* is not known, but as *Varanus* specimens infected with this worm inhabit swampy, mangrove or riverine habitats, a crustacean intermediate host is possible. Although *V. indicus* feed on a wide range of prey, the fact that crustacean remains were found in 16 of 37 from Papua New Guinea and the Solomon Islands, and in only 2 of 20 from the Moluccas, (food data not available from lizards from Maningrida) illustrate local or regional differences in prey availability. The distribution of the worm in the present study may be related to the discontinuous nature of insular habitats. In the present study highest intensity of *T. tiara*, 22 – 123 worms, occurred in *V. indicus* examined from northern mainland Australia (Adelaide River and Maningrida), which may provide both more opportunities for the spread of worms and intermediate hosts than from small isolated habitats. Furthermore, *T. tiara* have been reported from *V. panoptes* Storr, 1980, *V. gouldii* (Gray, 1838) and *V. mertensi* Glauert, 1951, from aquatic habitats in northern Australia at mean intensities of 18.9 (max. 120 worms), 20.5 (max. 50 worms) and 7.2 (max. 30 worms) respectively; an absence of correlation with *Abbreviata* spp. infection

was also noted in that study (Jones 1988). The similar species *T. ophidis* Johnston & Mawson, 1948, described from the aquatic file snake *Acrochordus* sp. was present in all eight *Acrochordus* sp. examined from north and northwest coastal Queensland, at numbers ranging from seven to 179 per host (mean, 51); (Jones 1978). As *V. indicus, Acrochordus arafurae* McDowell, 1979 and *A. granulatus* (Schneider, 1799) are sympatric over much of their range, it is possible that these two species of *Tanqua* are also sympatric.

The single male *H. longissima* reported in the present study was probably an accidental infection, taken with infected prey. The type host and type locality of *Heliconema longissima* (Ortlepp, 1922) are given as 'snakes, Australia', although all other specimens have been recorded from anguilliform fish, and Ogden (1969), considered that the type host identification is probably in error. However, *H. longissima* occurred in 3/5 specimens of the aquatic colubrid snake *Fordonia leucobalia* (1, 23 and 41 nematodes per host; Jones 1978).

The scarcity of *Abbreviata melanesiensis* sp. nov. in *V. indicus* contrasts with findings of prevalence and intensity of *Abbreviata* spp. in other species of *Varanus* and other large terrestrial reptiles in northern and arid Australia, in several species of which infection with *Abbreviata* spp. occurs at high prevalence and intensity (Jones 1983b, 1988). Epidemiological evidence suggests that termites might have a role to play in the life-cycles of species of *Abbreviata* from arid regions (Jones 1995). Since only two *V. indicus* were infected with *Abbreviata* sp., no conclusions can be drawn from the absence of concurrent infection with *T. tiara*. Since *Varanus indicus* feeds on a wide variety of invertebrate (and, in the larger specimens, vertebrate prey; McCoy 1980) the nematodes present may relate to differences in diet; the predominance of aquatic prey in these lizards suggests that the intermediate hosts of *T. tiara* may be aquatic invertebrates. The fact that one of the two hosts infected with *A. melanesiensis* was particularly large may be significant. The larger of the two infected lizards contained a *Candoia* sp. snake prey item, and though it is possible that this *Abbreviata* infection was spurious, this is unlikely as several of the nematodes were already attached to and apparently feeding on the external surface of the snake.

Conclusion

This study demonstrates that despite the wide range of prey items consumed by *V. indicus*, this lizard supports gastric nematodes in low numbers, and at a moderate prevalence, with only three species recorded. No intestinal nematodes were recovered. It is possible that the large range of prey types may inhibit the development of parasite cycles, particularly in parasite species with narrow intermediate-host specificity. The low intensity of *T. tiara* and geographically uneven distribution may relate to the insular and discontinuous nature of the region from which *V. indicus* was examined; in this regard the higher intensities of this nematode recorded from other species of *Varanus* in northern mainland Australia may be significant. Further conclusions cannot be drawn without knowledge of the arthropod intermediate hosts required by this nematode to complete its life-cycle. Studies on the gastrointestinal parasites of other larger reptiles in this region may reveal a wider range of hosts for *A. melanesiensis*.

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